CONTENTS AND ABSTRACTS

The influence of Academician Arutyunyan ideas on contemporary mechanics and the development of his ideas in modern science are under consideration. Three main areas of Solid Mechanics are studied in details. They are viscoelasticity, contact mechanics, and mechanics of growing solids. The development of the theory of viscoelasticity is closely connected with ideas of aging and inhomogeneous aging. New directions in contact mechanics are defined by concepts of multi-body non-simultaneous contact and discrete accretion. Mechanics of growing solids progresses on the basis of modern geometry and use notions of physics and chemistry. These areas have numerous intersections and generate new problems which are of great importance both from the point of view of fundamental research as well as from the point of view of applications. The development of each area is illustrated by the statement of new problems, utilization of new methods and formulation of new mechanical phenomena.

The evolution the temperature field in the growing ball is studied in present paper. The law of the motion of growing surface that allow expressing the solution of the initial-boundary problem in closed form is determined. The spectrum of a linear differential operator generated by the problem is obtained.

In the present paper initial-boundary problem of plane linear micropolar theory of elasticity is considered in thin rectangular domain for orthotropic bar. It is assumed that the general stress-strain state can be divided to internal problem and boundary layers by coordinates and time. The internal one-dimensional problem and boundary layers by coordinates and time are constructed with the help of the asymptotic method. Corresponding boundary and initial conditions are obtained on the basis of interaction of the internal problem and mentioned boundary layers. As a result mathematical model with free fields of displacements and rotations of micropolar orthotropic elastic thin bars is constructed and the corresponding model of micropolar bars, constructed on the basis of hypotheses method, is justified.

An analytical solution for problem of healing of crack moving with arbitrary speed is done. The character of curves of healing process is investigated**.**

The linear problem of the static stability of an elastic rectangular plate in a supersonic gas flow is investigated. The flow is in a direction from the free edge to the hinge joint edge. At the two edges parallel to the flow are hinge joint. Its solution shows that the divergence is possible. There are two limiting cases, which can be reduced to this problem: the case of an elongated plate and the case of a semi–infinite plate-strip. In the latter case the phenomenon of the localized divergence instability arising in the vicinity of the free edge is observed. The critical values of the flow velocity have been found, which results in the divergence instability, depending on the sides of a plate and the Poisson's ratio.

measurements is offered. Restrictions imposed on the offered optical scheme are considered. The assessment of a range of measurements of values of displacements is given.

yield surface, its convexity, and the associated flow rule. Non-linear constitutive laws of heat propagation as of type-III thermoelasticity complying with the principle of thermomechanical orthogonality are discussed. Important for applied thermoelasticity cases covered by type-III theory are studied: GNI/CTE – conventional thermoelasticity based on the Fourier heat conduction law and GNII – dissipationless hyperbolic thermoelasticity. In the latter case the internal entropy production equals zero for any heat transport process having the form of the undamped thermoelastic wave propagating at finite speed.

The problem of normal and oblique interaction of the extended steel isotropic cylindrical striker with an orthotropic plate in a range of velocities of impact to 2000 m/sec in a case when the vector of velocity of the striker doesn't coincide with its longitudinal axis is considered. Influence of the angle of a nutation on destruction of a plate and on behavior of the striker in the process of penetration is investigated. The task is solved numerically, by method of final elements in three-dimensional statement. The behavior of a material of the striker is described by elastic-plastic model; the behavior of the material of a barrier is described within elastic-fragile model.

In this work the contact problem of an indentation of a flat punch into an elastic half-plane, when the contact region is divided into slipping and adhesion zones, is considered. A solution of this problem is reduced to a system of three singular integral equations respect normal and tangential stresses in the adhesion zone and contact pressure in the slipping zones. The solution of this system is built by the direct numerical integration with method of discrete singularities. Numerical analysis is shown a convergence of the computational process in dependence of degree of interpolation formulas. The graphs of contact stresses distribution is ploted. Dependence of a length of adhesion zone on a friction coefficient and Poisson ratio is investigated.

An elastic equilibrium of a thin circular sector with unit radius and arbitrary angle of opening α, when on the arc part of the contour normal displacement and tangential stress are given, and on the radial sides the conditions of the smooth contact takes place, is studied. A closed solution of the problem is obtained with the help of the method of variables separation. It was shown that in both cases, when the angle of the wedge tends to π or 2π, the stresses have degree characteristics of $r^{-1+\varepsilon}\ (\varepsilon \to +0)$ type, and the coefficients with such singularity in the conditions of general loading of the boundary arc part in the first problem are different from zero and in the second problem tend to zero. Here another case of loading of the arc part of the boundary sector is being analyzed.

In this paper on the basis of general theories of micropolar dynamic thin elastic plates with independent fields of transitions and rotations free vibrations of hinged-simply supported round plates are studied. Determination of natural frequencies is reduced to the solution of

transcendental equations. These equations are solved by numerical method. A multilateral numerical analysis was carried out. The results of numerical calculations are presented, that show the specific features of natural vibrations of thin round plates of micropolar elastic material.

by collocation method, the values of the coefficient of stress intensity near the edges of the crack were found.

with a stamp. The base of the stamp is rectangular, parabola, cylinder or sphere according to the system of coordinates. In the contact area for some problems are normal and shear stresses can be related to Coulomb's law. Normal and shear stress act on the stamp, stamp-base system is in terms of limiting equilibrium, for some problems on the stamp only normal load is applied. Through programs of analytical calculations are obtained integral equations of the first kind whose kernels are presented in explicit analytic form. The main properties of the kernels of integral equations are studied. It is shown that the numerator and denominator of the kernels symbols can be represented as a polynomial relatively the shear modules of the layers and space. The coefficients of these polynomials contain exponential and power function of the relative layers thicknesses and Poisson's ratio. Efficient schemes for solution of integral equations are proposed. The contact stresses, the size of the contact area, the relationship moving stamp and forces acting on it are calculated.

The system of equations describing propagation of elastic wave in dielectric crystals, which contain charged dislocations is derived. The coefficients of absorption and of velocity of linear wave are obtained. In case of nonlinear wave, when only quadratic nonlinearities are taken into account, the formulae for variation of amplitude and phase of wave with coordinate of wave probation direction are obtained.

In the work is considered the calculation method of flexible gear wheels of a wave transmission by semi-momentless theory with taking into account of the boundary effect of the connection of a gear crown by shells. The functions of the stresses and recurrent relations for to determination of an efforts, moments and force factors in arbitrary section of shells are obtained.

A contact problem of the theory of electroelasticity of infinite plate from piezo-elastic material with an elastic finite inclusion of variable rigidity is considered. The problem is reduced to the system of integral differential equations with variable coefficient of singular operator. Using the method of orthogonal polynomials we obtain the dual infinite system of linear algebraic equations. We can manage to investigate the obtained system on the quasi-regularity and the method of reduction for approximate solution is developed.

The theory of growing structures is a new and fast developing branch of analytical mechanics basing on the theory of partial differential and integral equations. In the present paper the authors analyze qualitative properties of growing rods subjected to longitudinal vibrations. This problem is described it terms of the linear classical, Rayleigh-Love and Rayleigh-Bishop models. It is assumed that the rod is fixed at one end and free at the other end and its length is increasing. For solution of this problem we make a special change of variables which transforms the original equations into new equations with variable coefficients. It is shown that these equations are hyperbolic and possess several interesting and important properties. First of all, the amplitudes of vibration of the rod are growing with time. For example, if the rod length is increasing proportionally to time the amplitudes are also growing proportionally to time. Secondly, if a particular mode is excited it excites other modes. In this case the mechanism of the modes excitation is asymmetric, which means that the low frequency modes possess higher amplitudes compared to the higher frequency modes. The physical explanation of these phenomena is proposed and discussed.

Regular structure materials are used in different technological processes. Therefore, investigation of the mechanical properties of these materials is of considerable practical interest. These mechanical properties are represented by the relationship between average stresses and effective strains, which can be obtained from the solution of the problem for elastic plane. In this paper, we employ the model of an elastic plane having a biaxial periodic system of round holes to analyze the dependence of the effective elastic parameters on the direction of applied loads and the geometrical characteristics of the system. Parameters anisotropy is demonstrated. The abnormally high values of Poisson's ratio, which are impossible in isotropic media but observed in some anisotropic media, are found.

The presented work is devoted to the new method of energy storage rate determination that allows to obtain distribution of this quantity on the surface of deformed specimen. The method is based on the experimental procedure for simultaneous measurements of temperature, and displacement distributions on the surface of tested specimen during tensile deformation. This procedure involves two complementary imaging techniques: CCD technique and infrared thermography (IRT). It has been shown experimentally that during evolution of plastic strain localization the energy storage rate in some zones of deformed specimen drops to zero end even to negative values. To interpret this result in terms of micro-mechanisms, microstructural observations using electron back scattered diffraction (EBSC) and transmission electron microscopy (TEM) were performed on specimens in different states of deformation.

Some of the principal features of the behavior of materials subjected to impact actions are common for a number of seemingly quite different physical processes, such as dynamic fracture (starting cracks and spalling), cavitation in liquids, and electrical breakdown in solids. The examples of different physical processes considered in the paper show the fundamental importance of investigating incubation processes preparing abrupt structural changes (fracture, yielding and phase transitions) in continua under intense pulsed actions.

The propagation of electro-magneto-elastic coupled shear waves in a piezoelectric waveguide is considered within a full system of the Maxwell's equations. Two different conditions along the guide walls have been studied in the case of periodic electrically shorted interfaces. It has been shown that under electrically shorted periodic transmission conditions the Bloch-Floquet waves exist only at acoustic frequencies. The results demonstrate the significant effect of piezoelectricity on the widths of band gaps at acoustic frequencies.

This paper present results of experimental and numerical research of reinforced concrete columns and joints at short-term vertical dynamic loading, which have yielded new results of the stressedly-deformed condition and schemes of fracture.

Hydraulic structures being structures of first class require meeting the safety operation conditions. To secure safety operation conditions of earthfill dams it is important to evaluate their coefficients of stability and strength factor by calculation of mode of deformation of dam body. To complete these calculations the dam body soil actual state observation has to be carried

out by experiments. Based on experimental data the mode of deformation of dam body is revealed by software modeling investigations, and safety operation conditions are evaluated. The mode of deformation is defined by nonlinear equations, which specify elasto-plastic state of dam body soil. Hydraulic structures safety and stability evaluation methods are elaborated in case of dynamic impact.

We present a general approach to the paradox of Nicolai and similar effects analyzed as a singularity of the stability boundary. We study potential systems with arbitrary degrees of freedom and two coincident eigenfrequencies disturbed by small non-conservative positional and damping forces. The instability region is obtained in the form of a cone having a finite discontinuous increase in the general case when arbitrarily small damping is introduced. This is a new destabilization phenomenon, which is similar to the effect of the discontinuous increase of the combination resonance region due to addition of infinitesimal damping. Then we reconsider the paradox of Nicolai: the instability of a uniform axisymmetric elastic column loaded by an axial force and a tangential torque. It is shown that the paradox of Nicolai is related to the conical singularity of the stability boundary which transforms to a hyperboloid with the addition of small dissipation.

The framework of elasto-hydro-dynamic lubrication theory [1] is discussed in this paper. The theoretical plane contact problem of a liquid friction rotating about a cylindrical axis with a fixed non-deformable elastic cylindrical bush is presented. An elliptical ring cross-sectional shape is considered for the bush. The particular case of plane contact problem, when the interaction of these bodies is in the boundary lubrication regime was discussed in [2]. The problem is reduced to a closed system of nonlinear integral equations. A complete mathematical analysis of this system is carried out on the principle of contracting mappings developed in [3] and a numerical analysis is used in the design of sliding bearings.

We study the problem about harmonic oscillations of the elastic structure of rectangular shape upon a foundation, in the case when oscillations are caused by a seismic wave arriving from below. The structure is placed on the elastic half-space. In order to protect the structure from the incoming seismic waves, there is applied a special isolation from vibrations by some damping media modeled by a classical viscoelastic material of Kelvin-Voigt type.

The effect of ageing on the dissipative properties of getinacks subjected to repeated static loading has been investigated. Specimens were tested at the age of 1, 4, and 8 years. The approximation of experimental data is done, and the energy of dissipation is calculated. The hysteresis characteristics have been obtained at the values of strength close to the values of its ultimate strength. Based on the investigation of getinacks manufactured by the technology of regulated thermo-pressing, this technology can be recommended for the manufacturing of appropriate products.

In the first part we give the generalized form for kernels when the mathematical models for elasto-creeping materials are linear and homogeneous. The foundations of these results are some achievements gathered by groups of engineers and mathematicians from Zavriev Institute of SM & EE and Vekua IAM in the period 1968-2005 from great influences of Arutiunian's heritage. In the second part we present the method of constructing 2Dim with respect to spatial coordinates nonlinear dynamical for a mathematical models of von Kármán -Reissner-Mindlin type for viscous -elastic thin-walled structures and corresponding governing relations without any simplify hypothesis of mechanical or geometrical meanings and Volterra's principle.

The problem of intraocular pressure measurement modeling by a pneumotonometric method

The procedure of measuring the intraocular pressure by an optical analyzer is numerically simulated. The cornea and the sclera are considered as axisymmetrically deformable shells of revolution with fixed boundaries; the space between these shells is filled with incompressible fluid. Nonlinear shell theory is used to describe the stressed and strained state of the cornea and sclera. The optical system is calculated from the viewpoint of the geometrical optics. Dependences between the pressure in the air jet and the area of the surface reflecting the light into a photodetector are obtained. The shapes of the regions on the cornea surface are found from which the reflected light falls on the photodetector. First, the light is reflected from the center of the cornea, but then, as the cornea deforms, the light is reflected from its periphery. The numerical results make it possible to better interpret the measurement data. Two types of boundary conditions arc compared; for each of them, the relation between the pressure in the air jet and the area of the surface from which the reflected light is recorded by the photodetector is analyzed.